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DESIGN & PROPERTY CONSULTANTS

St John's CEVAP School

Heat Decarbonisation Report

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1. EXECUTIVE SUMMARY

Concertus have been appointed to undertake an energy review of the existing buildings at St John's CEVA Primary School and provide input into a heat decarbonisation plan going forward.

The document establishes the findings of the site-specific survey undertaken, guidance on energy consumption and investigate viable methods to contribute towards reducing carbon emissions, along with budget costs to assist in enabling the Diocese to prioritise their works.

This report outlines measures in achieving carbon reduction at St Johns using core principals; of assessing the fabric first for potential upgrades and supplementing alongside low carbon heat technologies.

Site Address	St John's Church of England Voluntary Aided Primary School (CEVAP), Victory Road, Ipswich, Suffolk, IP4 4LE

It is recognised that with any decarbonisation works the financial implications this can have, therefore the order of priority works as suggested for the purpose of this report and illustration of potential carbon reduction is still subject to 'Client drivers' and or budgets available from either planned maintenance or external funding opportunities.

Recommendations have been provided based on an initial decarbonisation survey undertaken, existing energy assessments and general viability for upgrades, alongside budget costs associated with each suggested proposal:

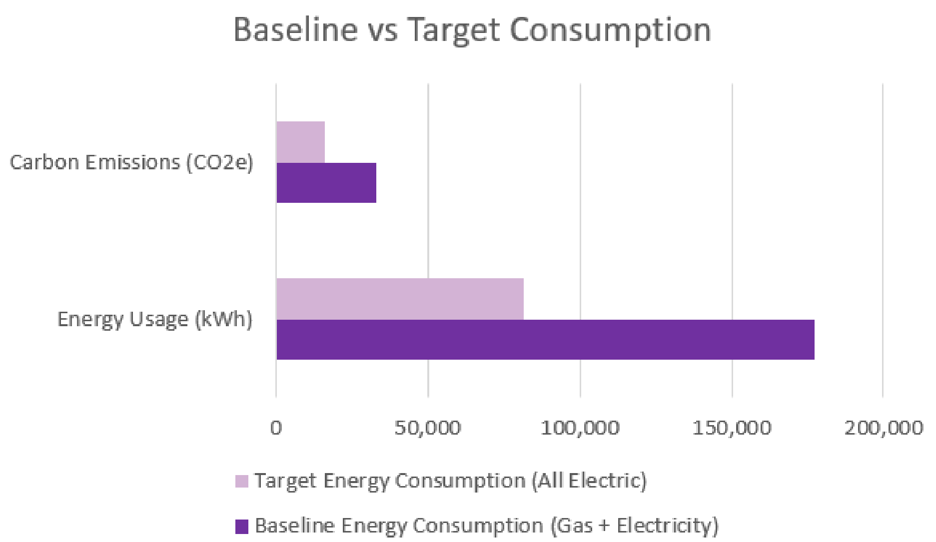
- Review potential upgrade to thermal performance of the older sections of the roof; scope to include roof replacement with added insulation levels to optimise U value.
- Fill the existing cavity walls where practical to do so.
- Convert the heating system currently served by 'gas fired boiler plant' installed in 2005 to be replaced as part of a carefully phased programme of works to Install ASHPs throughout.
- Note: Electrical infrastructure upgrade will be required to accommodate the revised / increased load attributed to ASHP plant.
- Upgrade of the lighting & associated lighting controls to minimise the energy in use attributed to lighting by providing a means for occupants to be more energy conscious.
- Introduction of roof mounted PV to help offset electrical load in use throughout the year.

1.1. SUMMARY OF TECHNICAL SOLUTIONS

Energy Saving Opportunity	Total Cost (all blocks)	Energy Reduction Impact %	Carbon Impact
Cavity Wall Insulation	£15,000	5%	Low
Roof Upgrade	£257,000	5%	Low
Lighting Upgrade & Controls	£150,000	12%	Medium
Installation of Photovoltaics	£24,000	14%	Medium
High Temperature ASHP with emitters, pipework etc	£615,000	67%	High

The above has been assessed on each energy saving opportunity available to the site and compared against the overall energy saving achieved to the current baseline to provide an overall carbon reduction impact achieved.

- 10% and below is scored as a low energy reduction impact.
- 10% - 35% is scored as a medium energy reduction impact.
- <35% is scored as a high energy reduction impact.



The above illustrates the current annual baseline of total energy consumption at the site against the targeted energy consumption with all applicable measures mentioned in the report taken into consideration. The comparison for carbon emissions has been compared to against 2022 carbon emissions factor. As the carbon factor for electricity further improves in the coming years/ decades, the carbon emission factor will continue to reduce for an all-electric system.

1.2. KEY PRINCIPLES TO NET ZERO

The overarching set of principles for achieving zero carbon buildings as illustrated by the Green Building Council (UKGBC) is to follow a 'reduction first' approach. This is the key priority for reducing operational energy, this often means a shift in mindset to only use what you need and switch off what you don't. Secondly, look to review/ increase the use of renewable energy to offset any remaining carbon.

As part of the assessment, a methodical approach has been undertaken to coincide with the framework definition of UKGBC.

A fabric first approach should be considered first as the main priority to reduce the heat losses to the building, with heating often being the most significant demand in terms of energy. This should then be complimented with energy efficient building services and supplemented with the addition of renewable technologies. The recommendations will therefore follow the core principals in achieving this Net Zero operation, however, it should be recognised that as part of the transition to an all-electric system, energy supplies chosen will need to be considered as 100% renewable electrical suppliers.

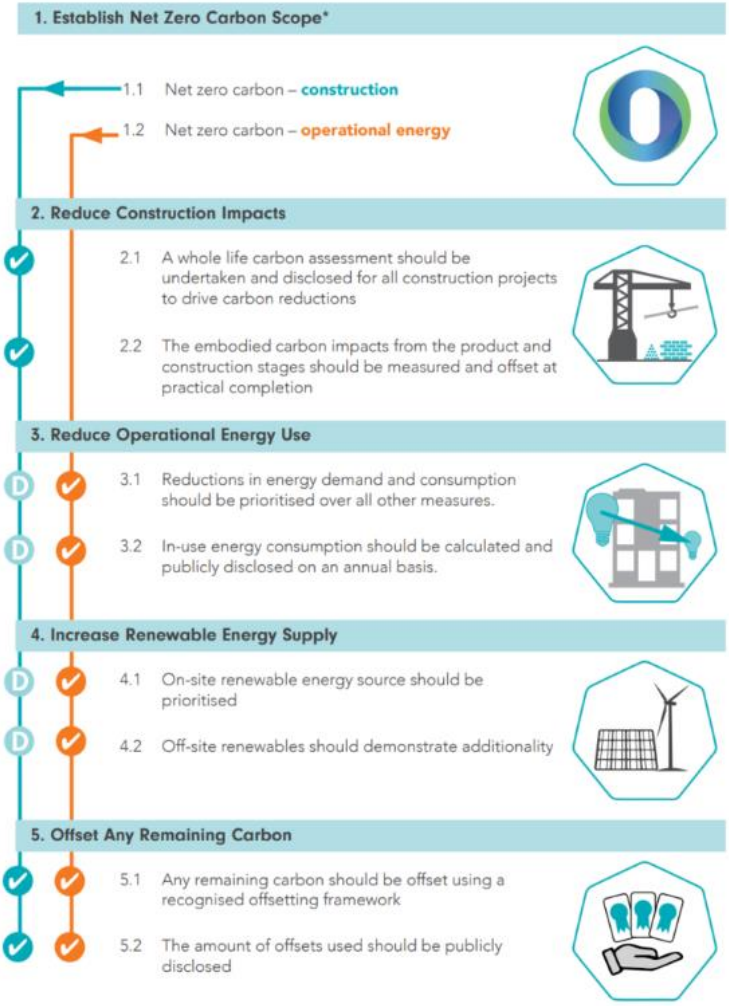


FIGURE 1 - UKGBC CARBON REDUCTION HIERARCHY

When reviewing the reduction of carbon emissions, there are 3 stages as follows:

Stage 1 – Passive design measures and features – 'Be Lean'.

Stage 2 – Passive and active energy efficient building services – 'Be Clean'

Stage 3 – LZC / Renewable energy provisions – 'Be Green'

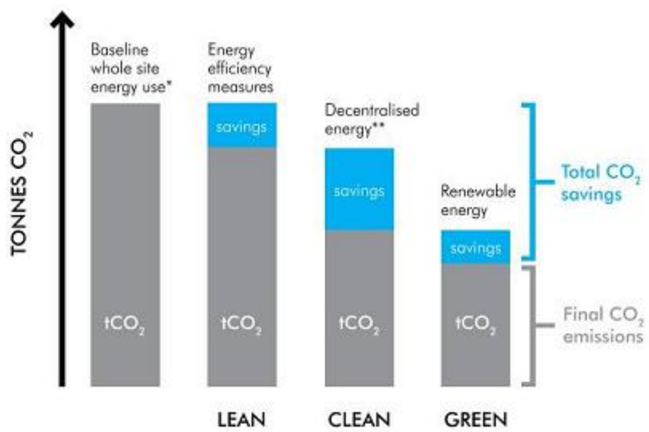


FIGURE 2 - ENERGY REDUCTION - IMPACT HIERARCHY

1.3. ORGANISATIONAL OBJECTIVES TO NET ZERO

In February 2020, General Synod set the Church of England an ambitious challenge to reach net zero carbon across the Parish, Cathedral, Diocesan and school estates by 2030. It recognised the mission of the Church is the mission of Christ and the Fifth Mark of Mission is to strive to safeguard the integrity of creation, and to sustain, and renew the life of Earth.

The Route-map to Net Zero Carbon by 2030 is the result of two and a half years of concentrated work and planning. It is recognised the 2030 target is hugely ambitious, but the process is as important as the target.

It is intended that The Church of England Route-map to Net Zero document will encourage all sections of the Church of England to see a way forward to achieve net zero by 2030 in a timely and realistic way without creating a feeling of burden.

The Route-map focuses on a variety of building types, but the key themes are as follows as extracted from the document:

- **Plan** – Review buildings/estate, identify what needs to be done and when. Setting suitable times for work, identifying if projects can be aggregated for cost-saving or to obtain funding and to optimise funds, skills and resources.

- **Maintain** – Keep on top of routine maintenance to reduce energy consumption and hence carbon emissions.

- **Reduce** – Consider where and why you are using energy and whether there are ways to reduce energy consumption and travel to eliminate carbon emissions. This includes changes in behaviour and ways of working, changes to heating and lighting systems and the use of different means of travel.

- **Opportunities** – Look for actions that reduce carbon emissions and also generate income (for example solar PV panels, electric vehicle charging points) and interventions that can deliver multiple benefits (for example reduced air pollution, community use, prevention of overheating in a warming climate).

- **Easy Wins** - Consider the easy wins to reduce emissions in all buildings: Establishing working groups, encouraging behaviour change, switching to green electricity and gas tariffs at point of renewal, replacing lighting with LED fittings and the development of replacement plans for plant and equipment.

Further information on the Routemap is available at the following link; nzc 2030 routemap june22.pdf (churchofengland.org)

1.4. DIOCESAN OBJECTIVES

In June 2021 the Diocesan Synod of the Diocese of St Edmundsbury & Ipswich passed a motion to action the 2020 General Synod motion to reach net zero carbon by 2030. The schools within the target are those which are under the influence or control of the Diocese. In respect of Voluntary Aided schools, the Diocesan Board of Education (DBE) allocates School Condition Allocation capital grant to address fabric needs, and therefore is in a position to influence the journey of these schools to reach net zero carbon.

In November 2021 the Diocesan Board of Education (DBE) adopted an environmental policy to achieve this in respect of the schools that are within the scope of the 2030 target. The policy contains the environmental vision of the DBE, and the strategic objectives.

One of the strategic objectives is to encourage all in-scope schools to commission Heat Decarbonisation Plans, which is fulfilled by this report.

To achieve net zero carbon, it is essential that the Diocesan Board of Education and school governing bodies work together to co-ordinate capital planning and access external funding.

2. INTRODUCTION

2.1. BACKGROUND

St John's C of E Primary School is situated in the North-Eastern part of Ipswich within a residential location. The original school building dated back to 1860 when the school was originally located in Cauldwell Road, Ipswich.

The school was then relocated to this site at Victory Road, Ipswich in 1961. Archived information for the site illustrates that the overall buildings have retained a similar footprint to that in 1961 with some minor refurbishment and extensions to the present day.

FIGURE 3 - ST JOHN'S - ORIGINAL FLOOR PLAN (1961)

2.2. SITE

The existing site consists of three blocks: two teaching blocks and the main block.

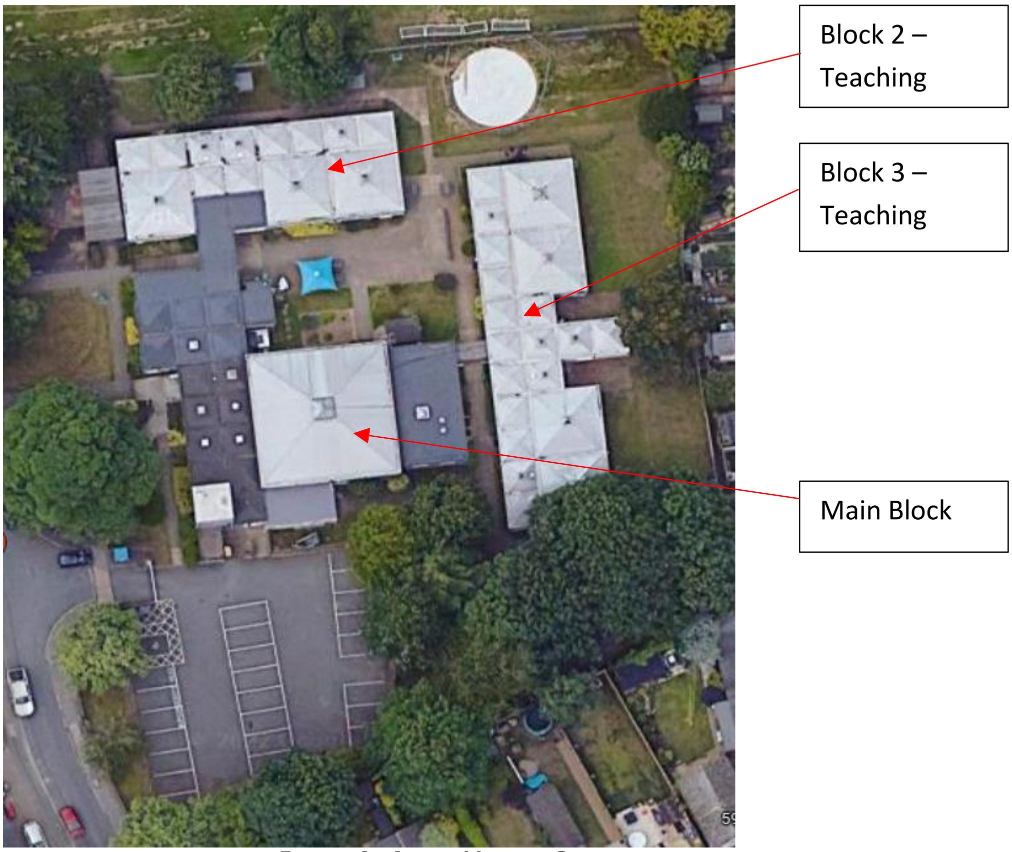


FIGURE 4 - AERIAL VIEW OF SITE

2.3. SITE SPECIFIC CONSTRAINTS & OPPORTUNITIES

A list of site-specific constraints and opportunities have been reviewed as part of this report following a non-intrusive site inspection.

Constraints:

- Current electrical capacity
- Plant/ equipment which have generally met or close to operational life expectancy
- Additional noise created from air source heat pumps within a residential setting
- Poor thermal efficiency of the building
- Programme of works – to avoid disruption to teaching and a live site, works are best to be undertaken during the summer break.

Opportunities:

- Space for air source heat pump (ASHP)

- Opportunity to phase blocks to each have an air source heat pump, aligns with programme constraints.

2.4. EXISTING SYSTEMS – OPERATIONAL LIFE

The below provides information on the indicative equipment lifecycle based on CIBSE Guide M for the various mechanical and electrical services present. This needs to be considered as part of the wider scope of works and the costs associated for the upgrade to an ASHP can additionally be accounted for within planned maintenance programme that may also coincide at the same time.

The table provides an overview of when major plant replacement occurrences and have been evaluated against the services at the site. It is important to note that this is a brief analysis and does not constitute a detailed condition report.

Equipment	Economic Life (Years)	Percentage of installation past economic life	Condition	Comments
Mechanical Installation				
Gas-fired boilers	20	0%	Average	Boiler replacement was undertaken in 2005. Boilers are beginning to show signs of wear and coming up for replacement. Issues highlighted from recent boiler service undertaken.
Hot Water Storage Cylinders	20	100%	End of life	Reached end of life. While this is still operational, cylinder is now oversized for intended use. Replace alongside ASHP replacement.
Steel heat distribution pipework	35	90%	End of life	Pipework is assumed to be original with some local repairs and modifications over time. While condition is reasonable – expect issues to arise in the future.
Copper pipework distribution	45	60%	Average	Pipework is in reasonable condition but expect issues to arise on older pipework sections. Some local modifications in teaching blocks have occurred and new refurbishment of toilets/ changing rooms etc.
Fan convectors – Main Block	15	20%	Good	Several fan convectors appear relatively new as part of refurbishment.
Fan Convectors – Teaching Blocks	15	100%	End of life	Fan convectors have reached end of operational life but still operational.
Panel radiators – Main Block	20	50%	Average	Sporadic radiator replacements in the Main Block. Some new and some reaching end of life.

				Column radiators assumed original and have reached end of life.
Equipment	**Economic Life (Years)**	**Percentage of installation past economic life**	**Condition**	**Comments**
Panel Radiators – Teaching Block	20	80%	Generally, end of life	Generally, installation consists of column radiators with some newer radiators added.
Heating loops – Teaching Block	35	100%	Average	System is assumed to be original. While operational, expect issues to arise in the future.
Localised electric heating – Teaching Block	8	0%	Good	
Localised Electric Water Heaters – Main Block	12	25%	Overall Good	Generally modern replacements.
Localised Electric Water Heaters – Teaching Block	12	20%	Overall Good	Generally modern replacements.
Localised Extract Fans – Main Block	10	20%	Overall Good	Generally modern replacements as part of refurbishments.
Mechanical control panel	15	100%	End of life	Has now reached end of life but still operational. To be replaced as part of new plant room installation.
Electrical Installation				
Main Switch Panel	20	EICR overall assessment of the installation in terms of its suitability for continued use has been given an Unsatisfactory rating		
LV Switch gear and distribution boards	20			
LV Cables and wiring	30			
Fluorescent Lighting	20 (depending on lamp)	Generally reaching end of life		Lighting due for replacement

FIGURE 5 - EXISTING SYSTEMS - OPERATIONAL LIFE

3. EXISTING MECHANICAL & ELECTRICAL SERVICES

3.1. PLANT ROOM

The plantroom is located within the main block of the school adjacent to the main commercial Kitchen.

The heating plant was originally oil-fired when the building was first opened and later converted to a gas service.

The existing plant is gas heated with 2No. Broag-Remeha Gas 210 Eco boilers with an output of 160 kW each. The system was installed in approximately 2005 and while this is still within the operational life, the boiler system is coming up for replacement in the next couple of years.

The overall system comprises of the following circuits:

1. Main heating system
2. Primary heating – domestic hot water service

The main heating circuit is variable temperature and incorporates weather compensation.

It was noted that from a recent service that the boilers are currently experiencing high temperature problems and have currently been recommended for replacement.

3.2. EXISTING PLANT ROOM SCHEMATIC

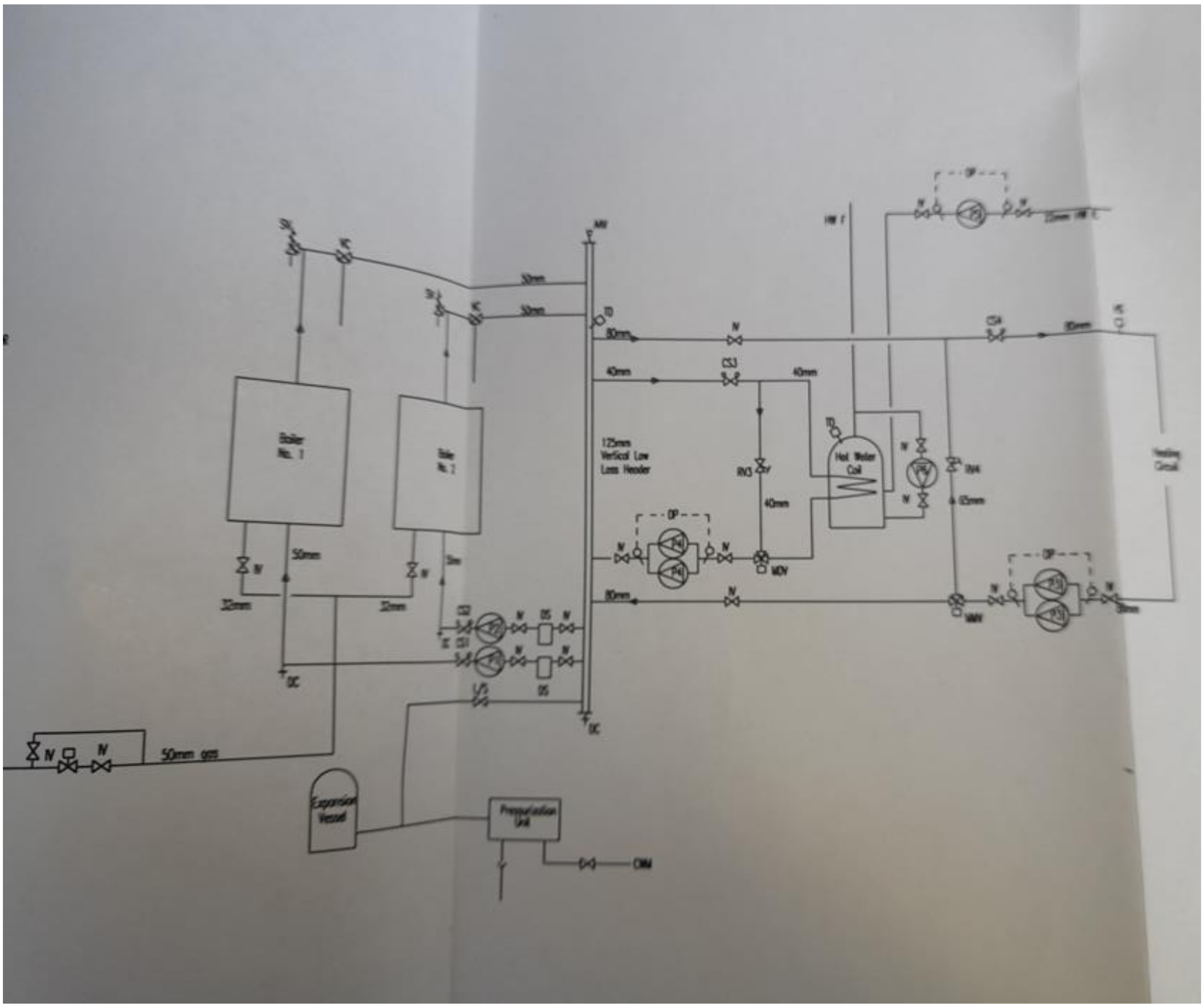


FIGURE 6 - EXISTING PLANT ROOM SCHEMATIC

3.3. SPACE HEATING

Space heating is a traditional wet based central heating system with a traditional flow and return system and primarily installed with steel pipework.

The system generally comprises of a variety of fan convectors, panel radiators, column radiators and a selection of heating loops.

Fan convectors are installed in the classrooms, library, main hall, kitchen, and changing rRooms. The remainder of administration areas, general group rooms and circulation spaces are provided with panel radiators. A selection of low-level heating loops were also observed in the former cloakroom areas.

The system is currently operating at an 80-60 °C flow and return temperature. The plant is anticipated to have originally been selected based on an 82-71°C flow and return temperature.

Within the teaching blocks, several wall mounted electric fan heaters were spotted and during survey no longer operational. It was evident that this was likely part of the original heating system when the building was first opened.

3.4. SPACE COOLING

No elements of space cooling were spotted during the survey.

3.5. DOMESTIC HOT WATER SERVICES

Hot water to the blocks was originally supplied from a central indirect hot water cylinder served with heating from the gas fired boiler.

It was noted during the survey that the two teaching blocks have been modified since to be provided with hot water from electric point of use water heaters incorporating local storage.

Within the main block, the changing rooms, cleaner's cupboard and Accessible WC are served from electric point of use water heaters.

It is anticipated that the existing hot water cylinder within the plant room only serves the commercial kitchen and 1 other room. The existing storage at present is therefore oversized from the original design basis.

3.6. INCOMING ELECTRICAL UTILITY SUPPLY

The incoming electrical supply is located on the ground floor electrical cupboard opposite, the reception area. The supply itself appears to be a 100A three phase supply, fed from an underground PILC cable terminating into an old style Three phase head. The earthing arrangement is TNCS. On the existing main head there are handwritten notes indicating that the main fuses are larger than 100A's, however this has not been verified due to the inability to access the main fuses to confirm. The meter at the time of inspection was an old fashioned magnetic rotary meter, with other old style magnetic sub meters most likely to meter the kitchen supply. However, it was not possible at the time of inspection as meters were not labelled or noted on the distribution schematic. We were advised that a smart meter had been arranged to be fitted.

3.7. POWER DISTRIBUTION

The power distribution in the main electrical cupboard is mostly an old style 100A MEM switch gear terminating in an MEM busbar system. Due to the age of the switch gear, it is likely to contain asbestos, however there is no labelling or information in the asbestos register to confirm this. The local distribution boards are a mixture of old-style MEM distribution boards, newer Schneider and Hager boards. These for the most part are non-compliant as detailed in the latest electrical installation condition report (EICR). At the time of inspection, the EICR was overdue.

3.8. LIGHTING

The school comprises mostly of fluorescent lighting with a mixture of T5 and T8 luminaires. There are a small number of fittings that have been replaced with LED as the fittings have failed. For the current lighting, there is no provision for automatic lighting control in the way of presence or absence detection. This leaves the building vulnerable to lighting being left on when not required.

3.9. EV CHARGING

There are currently no electric vehicle charging points installed at the site.

3.10. EXISTING RENEWABLES ON SITE

There are currently no renewables installed at the site.

3.11. RENEWABLE ENERGY FEASIBILITY

An initial renewable feasibility has been explored for the site to determine viable options which could merit further investigation and those that have been initially discounted.

Low Carbon Heating Technology									
Technology	**Description**	**Fuel Source**	**Space Required**	**C02 Reduction Potential**	**Reliability**	**Planning Issue**	**Programme Risk**	**Suitability for site**	**Practical Implementation**
Ground Source Heat Pumps	Energy extracted from the ground to raise the temperature of a heating circuit. Provides a low grade of heat typically serving underfloor heating or over-sized radiators.	Electrical input.	Large external space required.	Medium to High depending on system efficiency.	Almost consistent performance throughout the year due to ground temperatures. However, if not maintained correctly seasonal efficiency can be affected.	Low Risk	High Number of risks associated with initial ground investigations require to assess thermal ground performance. Drilling rig delays that are being experienced and large quantity of water required for drilling. Difficulty to programme works within summer holidays only	Careful design consideration required to successful integrate into scheme. E.g., borehole locations, heating emitters selected, specialist service investigations. Heating emitters would need to be replaced to suit the system. A selection of pipework will also need to be replaced to suit a change in flow rate.	Possible Could be investigated but due to risk associated and overall cost, it would not be recommended to take this forward.
Air Source Heat Pump (air to water)	Energy extracted from the air to raise the temperature of a heating circuit. Provides a low grade of heat typically serving underfloor heating or over-sized radiators.	Electrical input.	Large external space required.	Medium	Established technology that is able to operate at lower temperatures. SCOP is maximised at lower flow heating temperatures. High temperature air source heat pumps are traditionally more suited to refurbishment projects.	Low- Medium Risk Depending on location.	Medium Currently experiencing delays in air source heat pumps and key components.	Suitable for incorporation, however heating emitters would need to be replaced to suit the system. A selection of pipework will also need to be replaced to suit a change in flow rate	Yes It would be advisable to treat each block separately and have a phased transition to air source heat pumps for each block. This would also minimise risk with programme works i.e., if works are solely undertaken in the summer holidays.
Air Source Heat Pump (air to air)	Energy extracted from the external air to raise the temperature of a room air. Ability to provide reverse cycle between heating and cooling. Typically served indoor wall or ceiling mounted cassettes.	Electrical input.	Large external space required.	Medium	Established technology.	Medium Risk	Low-Medium Currently experiencing delays in air source heat pumps and key components.	Possible to explore with a phased introduction to each block.	Possible Can be explored further but not recommended. Air-to-air heat pump is not usually applicable for renewable funding incentives due to the ability of the units to provide cooling.

Technology	Description	Fuel Source	Space Required	C02 Reduction Potential	Reliability	Planning Issue	Programme Risk	Suitability for site	Practical Implementation
Heat Network	Heat networks (also known as district heating) supply heat from a central source to consumers, via a network of underground pipes carrying hot water. Heat networks can cover a large area or a cluster of buildings. This avoids the need for individual boilers in every building.	Dependent on heat network operator.	Existing plant room can be converted to accommodate heat exchangers and controls. No physical boiler space required.	Medium – High	Established system.	Low Risk	Medium – High	Not currently feasible for the site due to no heat network within the vicinity.	Not viable at present
Direct Electric Boiler	Direct electric boilers use electrical heating elements to directly heat the water.	Electrical input.	Can generally replace the current plant boiler space.	Low	Newly refined technology available in various outputs.	Low Risk	Medium.	Not recommended for site due to output required. Would be recommended for smaller scale buildings due to running costs of this type of system.	No
Combined Heat and Power (CHP)	Internal combustion engine working on compression cycle. Generates both heat and electricity as part of process	Biomass, biofuel.	Slight increased footprint compared to floor mounted commercial boiler.	Low depending on the fuel source used.	Regular maintenance to ensure optimal performance.	Medium – High Risk	N/a Not suitable for site	Not suitable for development due to limited heating baseload, significantly reducing ability for CHP to run effectively.	No
Biomass Boiler	Can burn a variety of wood materials, traditionally pellets for heating to raise the temperature for a heating circuit.	Generally wood pellets or wood chips.	Large spatial requirements for biomass store and plant.	Medium. Dependent on source of woodchip / pellets. Assumed to be grown by a sustainably.	Reliable depending on quality of woodchip / pellets.	Low Risk	Medium Risk can be managed but requires careful planning.	Could be opportunity to explore but biomass boilers are not the preferred method due to maintenance and operational issues that can be experienced. Existing emitters and pipework could be retained.	Possible

Technology	Description	Fuel Source	Space Required	C02 Reduction Potential	Reliability	Planning Issue	Programme Risk	Suitability for site	Practical Implementation
Solar Thermal	Water is pumped through solar collectors and sun raises the temperature of the water. Traditionally used to heat hot water provisions.	Solar irradiation.	Roof mounted plant.	Medium to High	Output dependent on average sunshine per year, usually greatest during the summer period. Additional system required to supplement and provide back-up of heating hot water.	Low Risk	Low	Not feasible for scheme. Greatest output achieved would be during the summer holidays. Current hot water system at the site would not benefit from incorporating the system.	No

FIGURE 7 - INITIAL RENEWABLE HEAT ASSESSMENT

Power Generation									
Technology	**Description**	**Fuel Source**	**Space Required**	**C02 Reduction Potential**	**Reliability**	**Planning Issue**	**Programme Risk**	**Suitability for site**	**Practical Implementation**
Photovoltaics	Energy is collected from solar irradiation and converted into electricity.	Solar irradiation.	Roof mounted plant.	Medium to High	Output dependent on average sunshine. However tried and tested technology.	Low risk	Low	Could be implemented but limited suitable roof space available.	Yes – limited solar array would be achieved.
Wind Turbine	Converts kinetic energy (wind) into electrical energy	Wind powered	Large area required, free from obstruction.	Low to Medium. Dependent on atmospheric conditions.		High Risk	Medium – High	Not suitable for site due to spatial constraints, planning issues being located within residential area etc. Small scale roof mounted wind turbine offer limit output for actual benefit achieved.	No

FIGURE 8 - INITIAL RENEWABLE POWER ASSESSMENT

4. EXISTING DEC REPORT

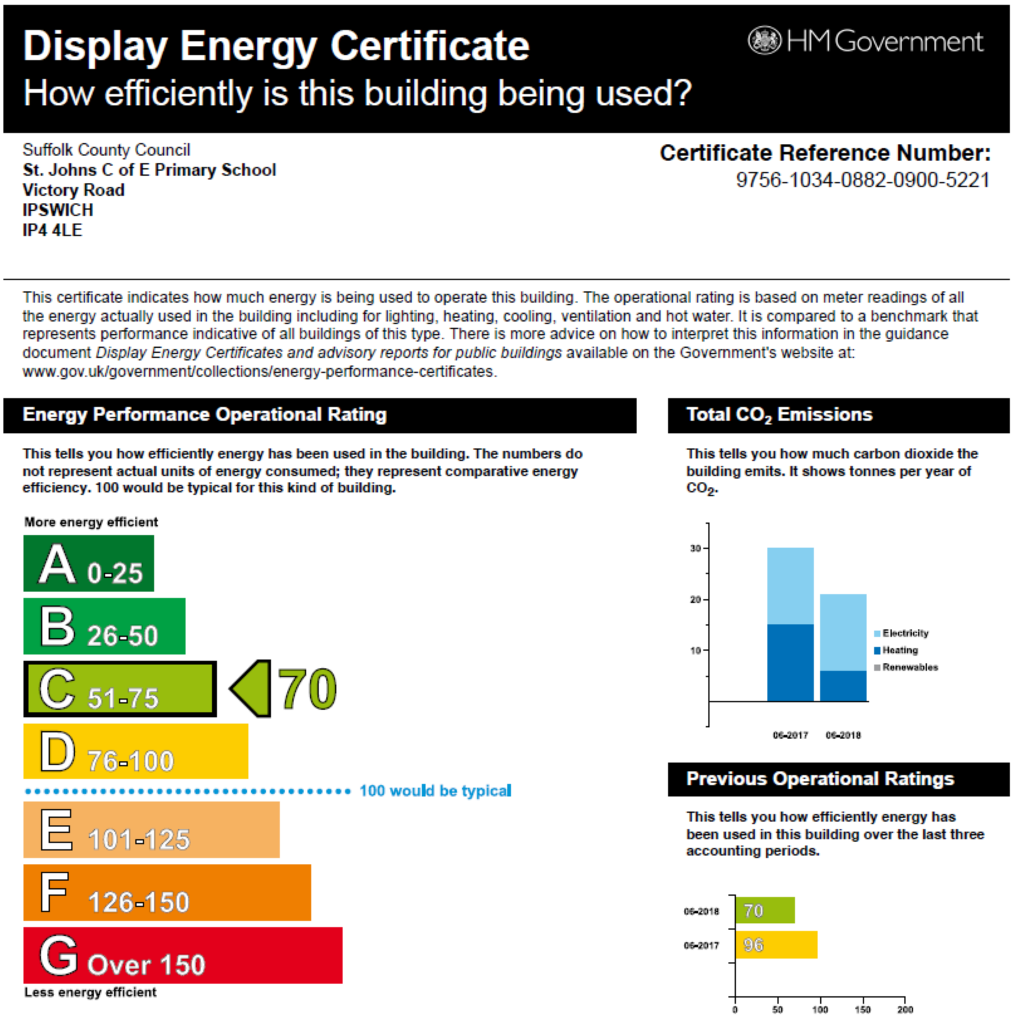
4.1. EXISTING ENERGY USAGE

The existing Display Energy Certificates (DEC's) have been reviewed for each respective block to evaluate the school's energy consumption, energy costs and annual CO2 emissions for the site.

A comparison has been provided against CIBSE online benchmark data for a Primary School and also additionally against the Department for Education (DfE) for energy targets for an existing school.

4.2. MAIN BLOCK

The Display Energy Certificate was produced in 2018. The rating received for the operational energy use of the building is a *'C'.* In the previous energy account period, the block was originally rated within a *'D'* category, showing significant steps to reduce energy use over the last three years.


Display Energy Certificate
How efficiently is this building being used?
HM Government

Suffolk County Council
St. Johns C of E Primary School
Victory Road
IPSWICH
IP4 4LE

Certificate Reference Number:
9756-1034-0882-0900-5221

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building including for lighting, heating, cooling, ventilation and hot water. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information in the guidance document *Display Energy Certificates and advisory reports for public buildings* available on the Government's website at: www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2.

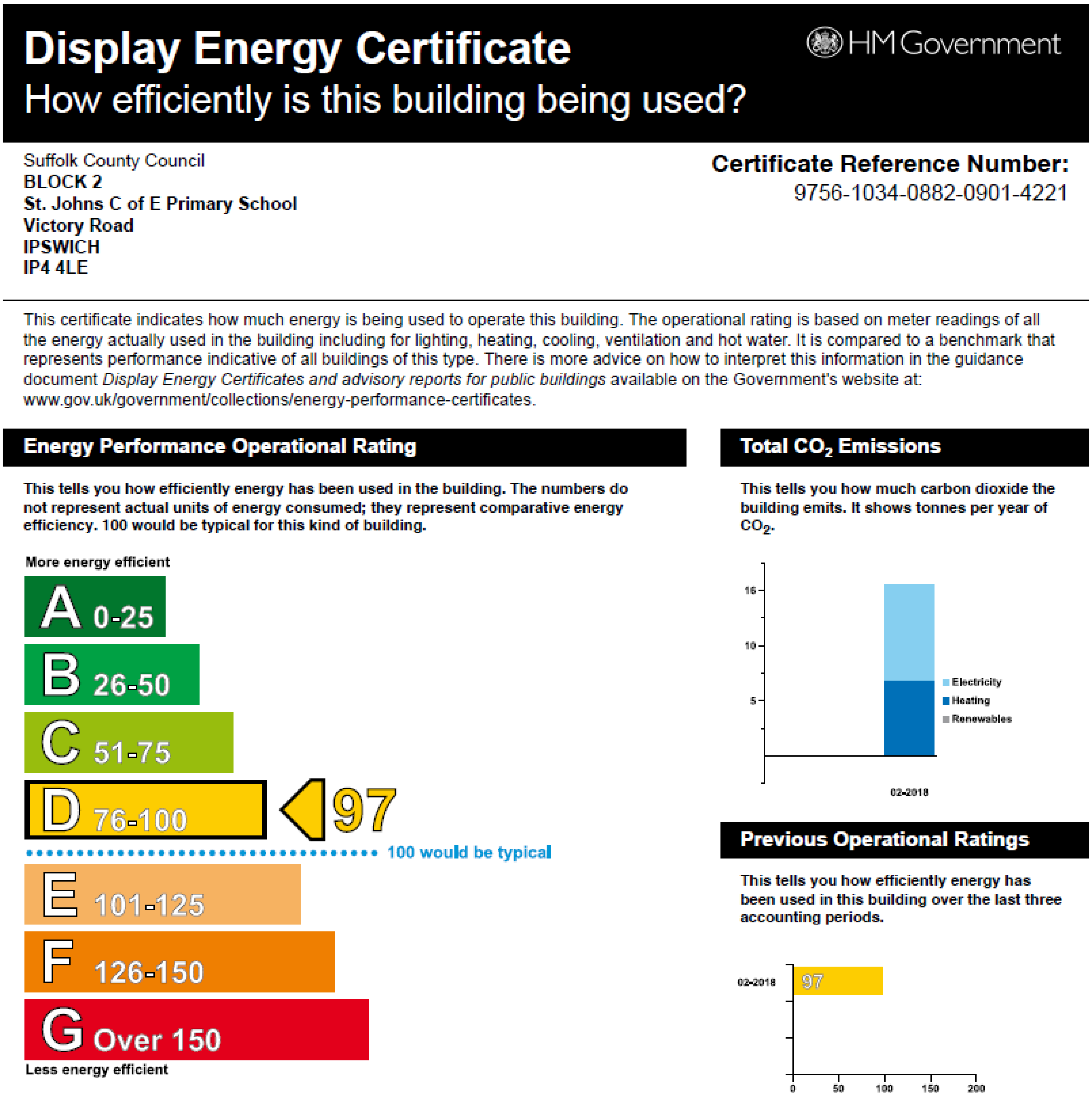
Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.

FIGURE 9 - MAIN BLOCK - DISPLAY ENERGY CERTIFICATE

4.3. BLOCK 2

The Display Energy Certificate was produced in 2018 and has remained at a '*D*' rating and just above the typical energy usage mark.



Display Energy Certificate

How efficiently is this building being used?

HM Government

Suffolk County Council
BLOCK 2
St. Johns C of E Primary School
Victory Road
IPSWICH
IP4 4LE

Certificate Reference Number:
9756-1034-0882-0901-4221

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building including for lighting, heating, cooling, ventilation and hot water. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information in the guidance document *Display Energy Certificates and advisory reports for public buildings* available on the Government's website at: www.gov.uk/government/collections/energy-performance-certificates.

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers do not represent actual units of energy consumed; they represent comparative energy efficiency. 100 would be typical for this kind of building.

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2.

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.

FIGURE 10 - BLOCK 2 - DISPLAY ENERGY CERTIFICATE

4.4. BLOCK 3

The Display Energy Certificate was produced in 2018 and has remained at a *'D'* rating and just above the typical energy usage mark.

Display energy certificate (DEC)

HM Government

Suffolk County Council
BLOCK 3
St. Johns C of E Primary School
Victory Road
IPSWICH
IP4 4LE

Operational rating
D

Certificate number:	0472-0918-5829-6324-2002
Valid until:	27 February 2028
Total useful floor area:	399 square metres

Energy performance operational rating

The building's energy performance operational rating is based on its carbon dioxide (CO2) emissions for the last year.

It is given a score and an operational rating on a scale from A (lowest emissions) to G (highest emissions).

The typical score for a public building is 100. This typical score gives an operational rating of D.

Score	Operational rating	This building	Typical
0-25	A		
26-50	B		
51-75	C		
76-100	D	96 | D	
			100
101-125	E		
126-150	F		
150+	G		

This building's energy use

Energy use	Electricity	Other fuels
Annual energy use (kWh/m2/year)	49	113
Typical energy use (kWh/m2/year)	40	149
Energy from renewables	0.0%	0.0%

Previous operational ratings

Date	Operational rating
February 2018	96 | D

Total carbon dioxide (CO2) emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO2.

Date	Electricity	Heating	Renewables
February 2018	11	9	0

Assessment details

Assessor's name	Roy Plumbley
Accreditation scheme	Stroma Certification Ltd
Employer/Trading name	Concertus Design & Property Consultants Ltd
Employer/Trading address	2 Friars Bridge, Ipswich, 1P11RR
Issue date	13 April 2019
Nominated date	28 February 2018
Assessor's declaration	Contractor to the occupier for EPBD services only.

FIGURE 11 - BLOCK 3 - DISPLAY ENERGY CERTIFICATE

4.5. HEAT DEMAND COMPARISON

Building	Gross Internal Area (m²)	Estimated Annual kWh	Estimated Annual Energy Use (kWh/m²/Yr)
Main Block	600	33,600	56
Block 2	315	35,595	113
Block 3	399	45,087	113
Total	**1,314**	**114,282**	

FIGURE 12 - HEAT DEMAND COMPARISON

Generally, the Main Block uses the least annual energy use per kWh/m² compared to the Teaching Blocks 2 and 3. This can partially be attributed to the recent roof upgrades undertaken to the Main Block and perhaps the general condition of the heating equipment within this block. The boiler room is located within the Main Block, so it is also additionally expected that heat distribution and performance is likely to be greater in the Main Block and decreased towards the Teaching Blocks due to the pipework length.

4.6. CIBSE BENCHMARK COMPARISON – FOSSIL FUEL

The Display Energy Certificate has been compared to with CIBSE online benchmarking data against other Primary Schools in the East of England. The sample size for the comparison is compared to 1360 sites in the region from recorded DECs.

Fossil Fuel Benchmark Comparison -						
Building	Good Practice Fossil Fuels (kWh/m²)	Typical Practice Fossil Fuels (kWh/m²)	DfE Target Challenge (kWh/m²)	Current Annual Usage (kWh/m²)	Compared to Good Practice	Compared to DfE Target
Main Block	102	129	39	56	57%	130%
Block 2	102	129	79	113	115%	130%
Block 3	102	129	79	113	115%	130%

FIGURE 13 - FOSSIL FUEL - BENCHMARK COMPARISON

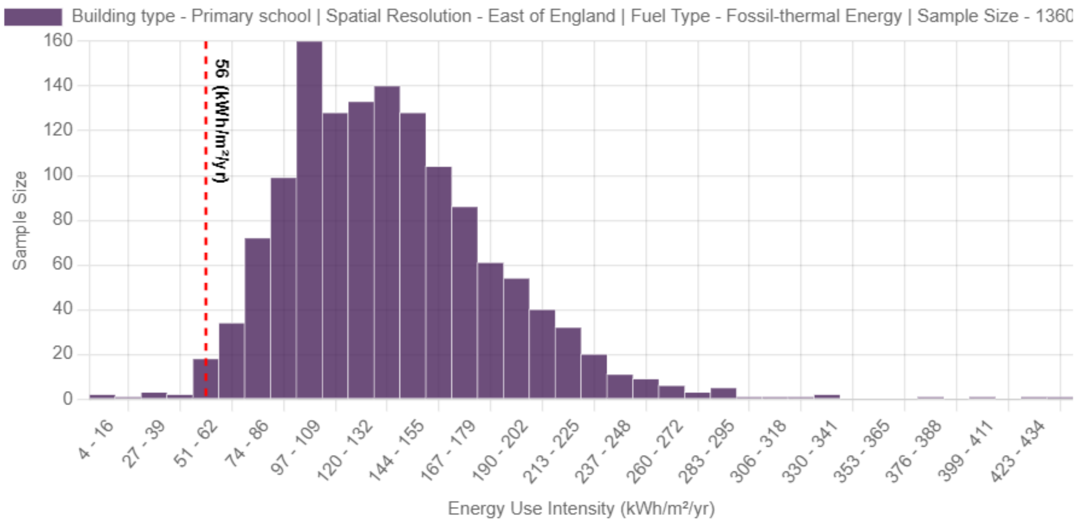
The Main Block is achieving above a 50% improvement over good practice for fossil fuel use per kWh/m². The Teaching Blocks are marginally over good practice values.

The DfE target challenge correlates to the reduction of energy and carbon associated with an existing building which sets out the below heat challenges to energy usage:

- Heating reduction by 30%

The above DfE initiative for the improvement to existing buildings can be used as a target for the overall reduction of heating and hot water reduction to the site working towards the overall net zero initiative by 2030.

Reductions in energy will be a natural progression over the years and should not be seen as a set target to reduce energy by within a year and instead should be seen as a long term initiative.



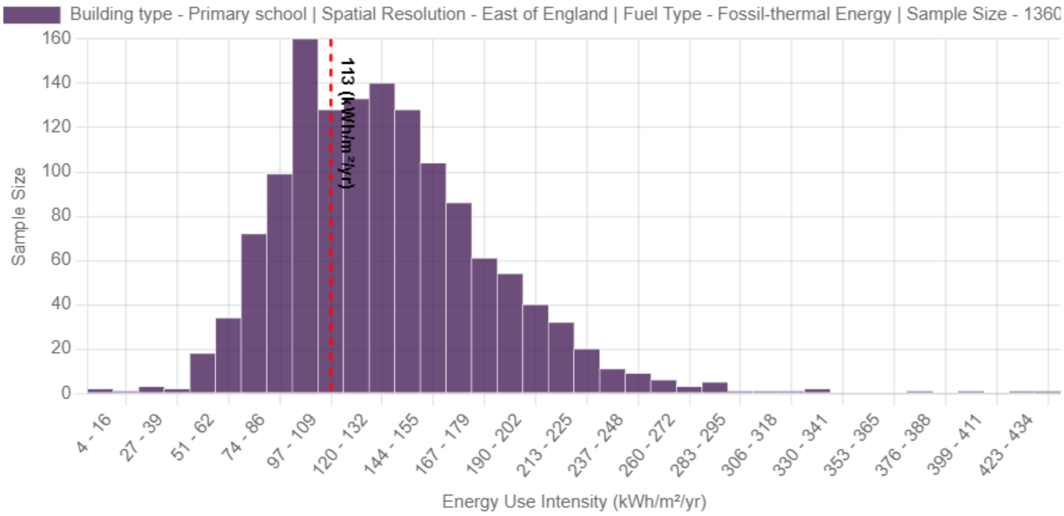
Building Type	Good practice fossil fuels	Typical practice fossil fuels	Source
Primary School	102	129	DEC

Showing 1 to 1 of 1 entries

* Energy consumption benchmarks for existing buildings in kWh/m²/yr unless stated otherwise

FIGURE 14 - MAIN BLOCK - FOSSIL FUEL COMPARISON

The graph above shows a comparsion of the Main Block to other Primary Schools located within East of England. This illustrates the Main Block is exceeding the tyical stock within the region.



Building Type	Good practice fossil fuels	Typical practice fossil fuels	Source
Primary School	102	129	DEC

Showing 1 to 1 of 1 entries

* Energy consumption benchmarks for existing buildings in kWh/m²/yr unless stated otherwise

FIGURE 15 - TEACHING BLOCKS - FOSSIL FUEL COMPARISON

The graph above shows a comparsion of the Teaching Blocks to other Primary Schools located within East of England. This illustrates the Teaching Blocks are within the typical range of buildings for the region.

4.7. ELECTRICAL DEMAND COMPARISON

Building	Gross Internal Area m²	Estimated Annual kWh	Estimated Annual Energy Use (kWh/m²/Yr)
Main Block	600	28,200	47
Block 2	315	15,435	49
Block 3	399	19,551	49
Total	**1,314**	**63,186**	

FIGURE 16 - ELECTRICAL DEMAND COMPARISON

Annual electrical energy usage per kWh/m² is relatively consistent across the three blocks and showing the expected trend for a Primary School building. While the main block consists of the commercial kitchen, administrations area, changing room and main hall, electrical usage when compared to the gross internal area would be relatively low due to occupancy and general time the spaces are used as a collective.

It is worth noting that teaching blocks would traditionally be energy intensive due to occupancy levels and times the rooms are used.

4.8. CIBSE BENCHMARK COMPARISON – ELECTRICITY

Electricity Benchmark Comparison						
Building	Good Practice Electricity (kWh/m²)	Typical Practice Electricity (kWh/m²)	DfE Target Challenge (kWh/m²)	Current Annual Usage (kWh/m²/Yr)	compared to Good Practice	compared to DfE Target
Main Block	34	41	33	47	138%	130%
Block 2	34	41	34	49	144%	130%
Block 3	34	41	34	49	144%	130%

FIGURE 17 - ELECTRICITY - BENCHMARK COMPARISON

Annual electrical energy usage per kWh/m² is over the good practice target. This could be attributed due to several electric point of use water heaters installed, a selection of electric heaters spotted during inspection and the combination of the extent of fluorescent lighting installed and limited energy saving lighting controls present.

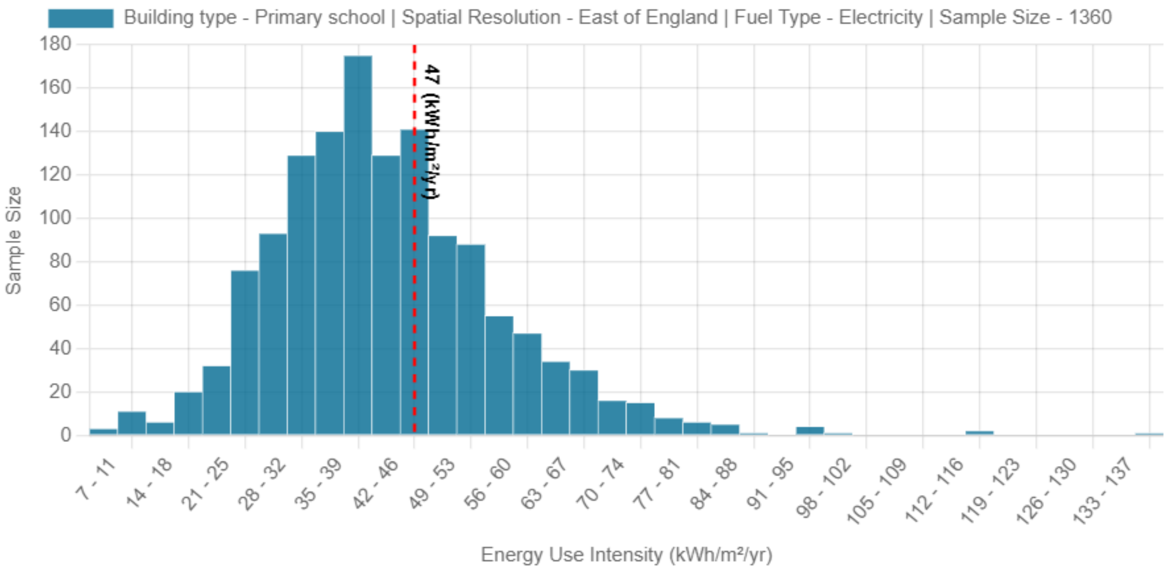
The power factor correction could also be an area for further investigation.

User habits can also be a factor for consideration for the usage of energy.

The DfE target challenge correlates to the reduction of energy and carbon associated with an existing building which sets out the below heat and electrical challenges to energy usage:

- Reduction of electrical usage by 33 % (includes overall usage of internal lightings, mechanical equipment loads, external lighting, small power, catering and ICT equipment usage)

The above DfE initiative for the improvement to existing buildings can be used as a target for the overall reduction of electrical usage to the site working towards the overall net zero initiative by 2030. Reductions in energy will be a natural progression over the years and should not be seen as a set target to reduce energy by within a year and instead should be seen as a long-term initiative.



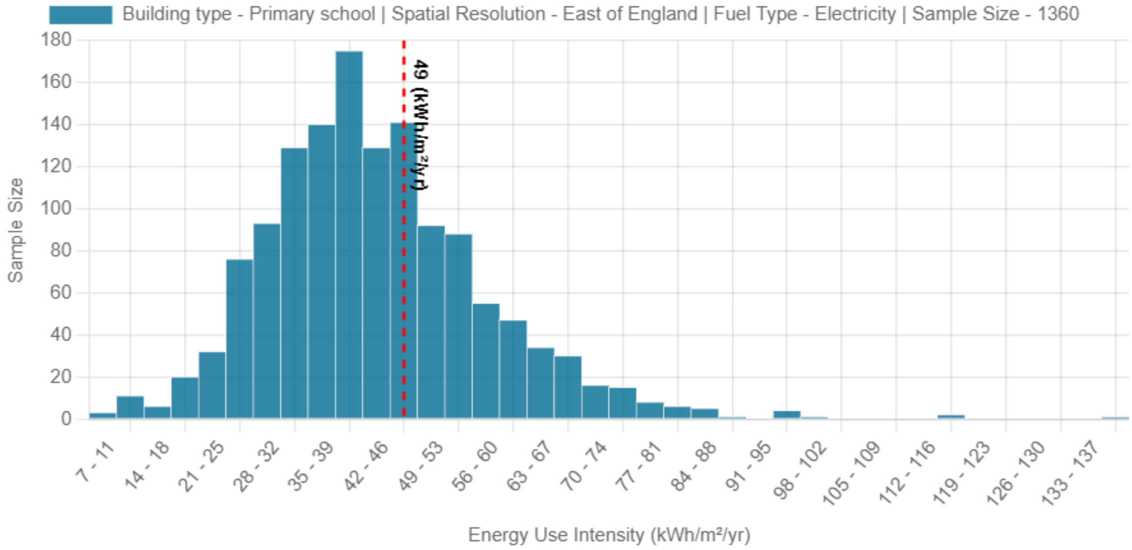
Building Type	Good practice electricity	Typical practice electricity	Source
Primary School	34	41	DEC

Showing 1 to 1 of 1 entries

* Energy consumption benchmarks for existing buildings in kWh/m²/yr unless stated otherwise

FIGURE 18 - MAIN BLOCK - ELECTRICITY COMPARISON

The graph above shows a comparsion of the Main Block to other Primary Schools located within East of England. This illustrates the Main Block is within the higher range of typical buildings for the region.



Building Type	Good practice electricity	Typical practice electricity	Source
Primary School	34	41	DEC

Showing 1 to 1 of 1 entries

* Energy consumption benchmarks for existing buildings in kWh/m²/yr unless stated otherwise

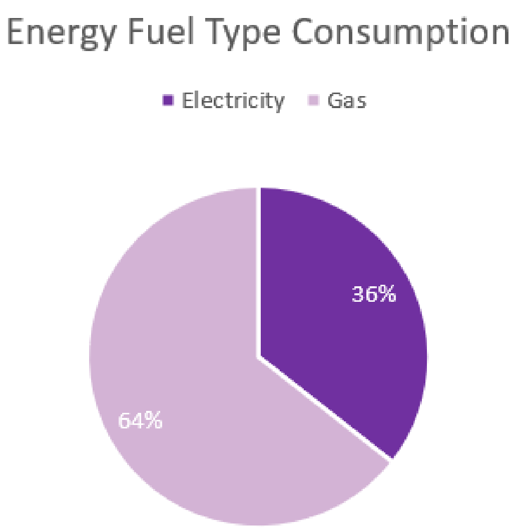
FIGURE 19 - TEACHING BLOCKS - ELECTRICITY COMPARISON

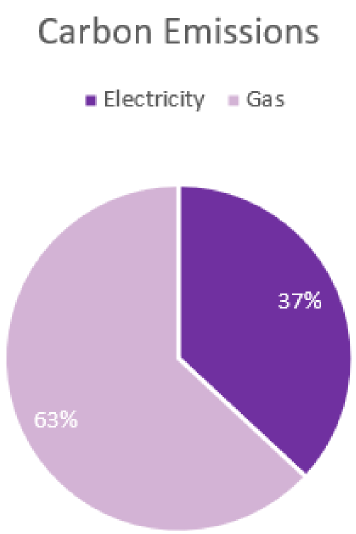
The graph above shows a comparsion of the Teaching Blocks to other Primary Schools located within East of England. This illustrates the Teaching Blocks are to within the higher range of typical buildings for the region.

4.9. SUMMARY – CARBON EMMISSIONS

DEC 2018	Annual Consumption		Annual CO_2 Emissions	
Utility	**kWh**	**%**	**KgCO2**	**%**
Gas	114,282	64	20,861	63
Electricity	63,186	36	12,219	37
Total	**177,468**	x	**33,080**	x

FIGURE 20 - ANNUAL CONSUMPTION & EMISSIONS REVIEW





5. EXISTING BUILDING ELEMENTS

5.1. BUILDING INFORMATION

St Johns Church of England Primary School was constructed in 1961. The buildings are primarily constructed of a concrete floor slab, with pre-cast concrete columns and timber beams supporting the roof structure. A brick and assumed block wall structure is assumed in some other areas. The roof arrangement is a grid system with the roof deck arranged into pyramid. This is covered in either an older EPDM roof covering, or a newer replacement built up felt roof system.

The school is arranged in three blocks, separated from each other by covered walkways. Several small extensions have been added, one dating to 1992 and another to 1994. These are brick and block construction with a flat roof structure.

5.2. BUILDING CONDITION

Generally, the school buildings are in a reasonable condition given their age. Several main elements of building fabric have been upgraded in recent years, such as uPVC windows throughout most of the site. The older EPDM roof coverings are undergoing replacement as budget becomes available to do so. The only building fabric element that justifies an upgrade based on condition as well thermal performance would be the remaining EPDM roof coverings. These are considered life expired and are expected to be replaced in the near future. An upgrade to insulation levels is necessary at the same time the roof covering is replaced.

5.3. THERMAL PERFORMANCE

The construction of the original buildings is poor performing compared to a more traditional brick and loadbearing block construction. The concrete beams are exposed externally and internally, presenting a cold bridging point. The edge of the floor slab is also exposed, allowing cold bridging between the external and internal areas of concrete floors. It is difficult to remove these cold bridging points, as the entire envelope of the building would need to be brought past these to insulate them. This would also affect the roofline, which would also need to be altered to suit the new possible installation. As the window sections make up a high proportion of the external envelope of the buildings, and these have recently been upgraded, it would more prudent to allocate funds to replace remaining EPDM roof areas and upgrades to mechanical and electrical services (if required).

Similarly, it is impracticable to upgrade insulation levels to the floor slab to remove the cold bridging potential or improve the thermal performance generally. This would require a prohibitive amount of disruption to remove and replace the existing slab and would result in significant costs to reinstate rooms once an upgraded floor structure was completed. Archive information indicates the sub-structure to the buildings is a raft type foundation, with minimal scope to reduce floor levels to allow insulation to be installed.

Insulation at roof level is assumed to either conform to current standards where the roof covering has been replaced with built up felt (achieving a u-value of a minimum of 0.18 W/m2K) or a minimal amount of insulation in areas covered with EPDM (as per archive drawings). It was not possible to establish the level of insulation in the EPDM roof areas due to the difficulty in ensuring a watertight repair.

5.4. THERMAL PERFORMANCE – EXISTING

Building Element	Build Up	Estimated Existing U Value (W/m2K)	Part L2B U Value (W/m2K)
Roofs	EPDM Roof Areas: Existing EPDM Membrane Tongue & groove 20mm deck 25mm insulation board Timber Joists, 100mm 100mm insulation board 20mm T&G cladding to ceiling	0.42W/m2K	0.18 W/m2K
External Walls	Original Building brick and blocks sections: Existing Brickwork, 102.5mm Cavity, 57.5mm Brickwork, 102.5mm Gypsum plaster	1.6 W/m2K	0.55 W/m2K
Windows	Existing PVC Double glazed with spandrel panels	1.6 W/m2K	1.6 W/m2K
Floor	Existing Solid concrete construction. (Unsuitable for upgrade)	0.37 W/m2K	0.18 W/m2K

FIGURE 21 - EXISTING U-VALUES

	Value	Unit	Additional Information
Building Thermal Capacity ΣUA	3,142	W/K	
Volume of Space to be Heated by Heat Pump	4,600.00	m^3	
Air Changes per Hour	1.50	ACH	*Naturally Ventilated Building*
Ventilation Loss	2,300	W/K	
Heat Loss Coefficient	5,442	W/K	
U'	5	kW/K	
Winter Internal Setpoint Temperature	20.00	°C	
Winter Outdoor Design Temperature	-5.00	°C	
Peak Building Heat Loss	**136.05**	kW	

FIGURE 22 - EXISTING ESTIMATED TOTAL HEAT LOSS

The above data provides an estimated heat loss based using an average U-values for the existing fabric of the buildings. The initial calculation providing an initial estimated heat loss of 136 kW. An additional heating load of 35-40 kW would also be applicable for the existing indirect hot water cylinders.

5.5. THERMAL PERFORMANCE – PROPOSED FABRIC UPGRADE

Building Element	Build Up	Existing U Value (W/m2K)	Potential U Value (W/m2K)	Estimated Energy Saving (kWh)
Roofs	Proposed Built up felt triple ply waterproofing system PIR insulation as part of manufacturers system Timber Joists, Retain existing internal ceiling.	0.42W/m2K	0.14W/m2K	5,740
External Walls **(Cavity Wall Infill)**	Proposed Brickwork, 102.5mm Cavity, 57.5mm Cavity Fill Insulation Brickwork, 102.5mm Gypsum plaster	1.6 W/m2K	0.48W/m2K	5,460

FIGURE 23 - PROPOSED FABRIC UPGRADES

	Value	Unit	Additional Information
Building Thermal Capacity ΣUA	2,599	W/K	
Volume of Space to be Heated by Heat Pump	4,600.00	m^3	
Air Changes per Hour	1.50	ACH	*Naturally Ventilated Building*
Ventilation Loss	2,300	W/K	
Heat Loss Coefficient	4,899	W/K	Saved to \\condata\users$
U'	5	kW/K	
Winter Internal Setpoint Temperature	20.00	°C	
Winter Outdoor Design Temperature	-5.00	°C	
Peak Building Heat Loss	**122.48**	kW	

FIGURE 24 - PROPOSED ESTIMATED TOTAL HEAT LOSSES

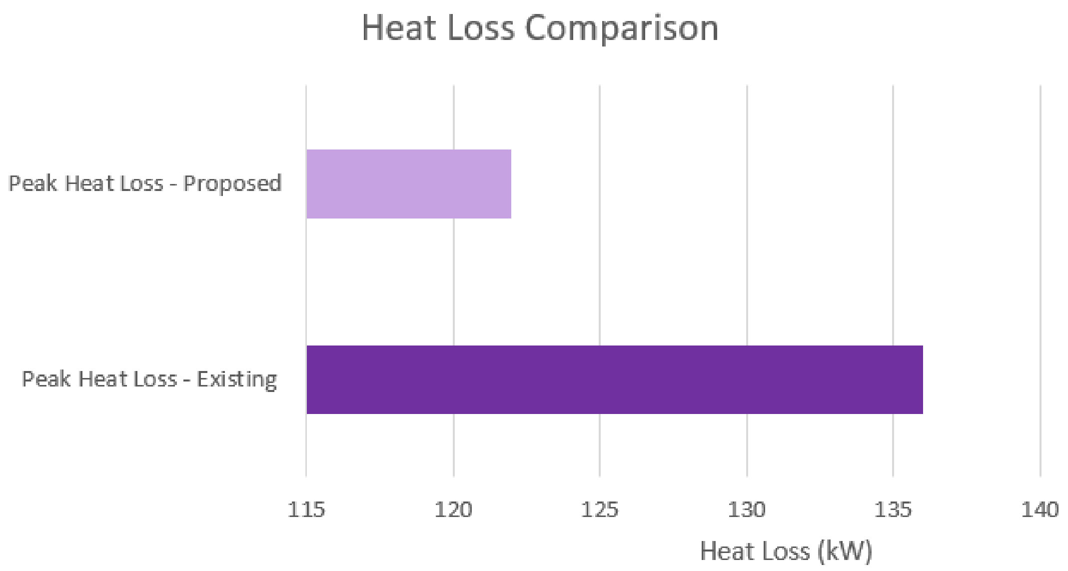


FIGURE 25 - FABRIC UPGRADE OVERVIEW

The above graph illustrates the heat loss reduction achieved following the recommended fabric upgrades.

6. PHASING & PRIORITY ORDER RECOMMENDATIONS

6.1. INTRODUCTION

The following summary of recommendations has been provided based on a priority order of 1 to 3 and typical timescales to incorporate into the buildings to work towards The Church of England Roadmap to Net Zero.

The order has been based on a methodical strategy with a fabric first approach to suit the future incorporation of a renewable heating system with the primary initiative to reduce the overall heating demand first. Consideration has also been provided to the operational life of the remaining plant/ equipment to the priority required.

It is recognised that with decarbonisation works the financial implications this can have and therefore priorities have been ordered to suit the stages for improvements to the overall vision to become Net Zero by 2030.

The priority numbers correspond as follows.

Priority 1 – Works for up to 3 years

Priority 2 – Works between 3- 5 years

Priority 3 – Works between 5 – 7 years

Priority 4 – Beyond 2030 to be investigated

(Subject to when the works are commissioned)

6.2. MAIN BLOCK

The following recommendations have been provided for the Main Block which comprises of the Administration areas, Main Hall, Commercial Kitchen, Changing Rooms, and other associated ancillary areas.

A fabric first approach should first and foremost be taken as the main priority to reduce the overall thermal load of the building and to suit the future conversion to an ASHP solution.

Existing electric point of use water heaters would be proposed to be retained for the Toilet areas, Changing Rooms and Cleaner's Store. The Staff Room (unable to identify at time of survey) would also be proposed to be provided with a local point of use electric water heater.

A high temperature air source heat pump would be recommended in this instance with the replacement of the existing fan convectors and a selection of radiators to suit the reduced output achieved.

The last priority for this block will be to replace the existing commercial kitchen gas equipment for an all-electric kitchen.

Component	Proposal	Reason	Priority	Overall impact to Carbon Reduction
Cavity Wall insulation	Investigate adding cavity wall insulation	Improvement to Wall U-value	Priority 1	Low
Lighting & Controls	Upgrade remaining lighting lamps to LED with energy efficient controls	Reduction of energy usage compared to existing fluorescent lighting	Priority 1	Medium
Air Source Heat Pump	Replacement of gas fired boiler plant	Transition from Fossil Fuel to all-electric system	Priority 1-2 (Phased Approach)	High
Electric Hot Water	Investigation to convert remaining systems to electric water heaters. Main challenge will be the Commercial Kitchen.	Separate heating and hot water systems.	Priority 3	Low
Installation of Photovoltaics	Install Photovoltaics to viable flat roofs	Supplement electrical demand for an all-electric system	Priority 2	Medium Overall scale of system achievable relatively low

Component	Proposal	Reason	Priority	Overall impact to Carbon Reduction
Commercial Kitchen Equipment	Replacement of gas equipment for an all-electric kitchen	Transition from fossil fuel source to electric.	Priority 3	Medium
Upgrade windows and doors to triple glazing	Investigate the replacement of existing double-glazed units to triple glazing	Further improve U-value to glazing elements	Priority 4	Medium

FIGURE 26 - MAIN BLOCK - SUGGESTED PHASED IMPROVEMENTS

6.3. NORTH BLOCK (BLOCK 2)

A fabric first approach again should first and foremost be taken as the main priority to reduce the overall thermal load of the building and to suit the future conversion to an air source heat pump solution.

The existing hot water provisions provided from electric point of use water heaters would be proposed to be retained and should be maintained accordingly for the foreseeable future.

A high temperature air source heat pump would be recommended in this instance with the replacement of the existing fan convectors and a selection of radiators and low-level heating loops to suit the reduced output achieved.

Component	Proposal	Reason	Priority	Overall impact to Carbon Reduction
Cavity Wall insulation	Investigate adding cavity wall insulation	Improvement to Wall U-value	Priority 1	Low
Roof Upgrade	Increase roof insulation	Improvements to Roof U-value	Priority 1	Low
Lighting & Controls	Upgrade remaining lighting lamps to LED with energy efficient controls	Reduction of energy usage compared to existing fluorescent lighting	Priority 1	Medium
Air Source Heat Pump	Replacement of gas fired boiler plant	Transition from Fossil Fuel to all-electric system	Priority 1-2 (Phased Approach)	High
Upgrade windows and doors to triple glazing	Investigate the replacement of existing double-glazed units to triple glazing	Further improve U-value to glazing elements	Priority 4	Medium

FIGURE 27 - BLOCK 2 - SUGGESTED PHASED IMPROVEMENTS

6.4. EAST BLOCK (BLOCK 3)

A fabric first approach again should first and foremost be taken as the main priority to reduce the overall thermal load of the building and to suit the future conversion to an air source heat pump solution.

The existing hot water provisions provided from electric point of use water heaters would be proposed to be retained and should be maintained accordingly for the foreseeable future.

A high temperature air source heat pump would be recommended in this instance with the replacement of the existing fan convectors and a selection of radiators and low-level heating loops to suit the reduced output achieved.

Component	Proposal	Reason	Priority	Overall impact to Carbon Reduction
Cavity Wall insulation	Investigate adding cavity wall insulation	Improvement to Wall U-value	Priority 1	Low
Roof Upgrade	Increase roof insulation	Improvements to Roof U-value	Priority 1	Low
Lighting & Controls	Upgrade remaining lighting lamps to LED with energy efficient controls	Reduction of energy usage compared to existing fluorescent lighting	Priority 1	Medium
Air Source Heat Pump	Replacement of gas fired boiler plant	Transition from Fossil Fuel to all-electric system	Priority 1-2 (Phased Approach)	High
Upgrade windows and doors to triple glazing	Investigate the replacement of existing double-glazed units to triple glazing	Further improve U-value to glazing elements	Priority 4	Medium

FIGURE 28 - BLOCK 3 - SUGGESTED PHASED IMPROVEMENTS

7. SUMMARY OF RECOMMENDATIONS

7.1. HEATING PLANT

The existing gas fired boilers are still within their operational life, however following a recent boiler service they are showing signs of underperformance. A replacement heating strategy needs to be considered and planned accordingly but this will not be a straightforward swap out for another gas fired boiler. As with all ASHP installations, this will take time to plan to ensure the system is designed effectively to maximise system efficiency and the associated lead-in times being experienced for equipment.

Pipework distribution and heating emitters will require replacement to accommodate an ASHP installation. The existing systems have generally reached end of life and so planned decarbonisation works could also coincide with any planned maintenance schemes. The timescales required to replace pipework distribution and emitters in a single scheme would likely prove to be both uneconomically viable and a risk to achieving the works within the summer holiday period alone. A phased approach to conversion to high temperature air source heat pumps would therefore be recommended and prove most beneficial in this instance.

The strategy proposed would be to decentralise the existing plant room and take each teaching block off the main heating system and introduce an ASHP to each block complete with new heating pipework distribution and emitters. The Main Block would be proposed to be the last remaining area to completely remove the existing gas fired boiler plant and convert to an ASHP. The Main Block will also prove the most challenging in terms of separating the hot water system from the main commercial kitchen.

7.2. DOMESTIC HOT WATER

The existing Teaching Blocks are served from electric point of use water heaters. It would be recommended that these are retained and replaced as and when the existing equipment comes to the end of its operational life.

Several hot water outlets in the Main Block are also provided from electric point of use water heaters. Again, it would be recommended that these are retained and replaced as and when the existing equipment comes to the end of its operational life.

The Commercial Kitchen is the main area the existing indirect hot water cylinder within the plant room currently serves. The strategy as part of the ASHP conversion would be to separate the space heating and hot water plant, which in experience has proved beneficial for commissioning and overall system performance.

7.3. LIGHTING UPGRADES

It was noted that 95% of the lighting fittings for the buildings are fluorescent lighting. An LED upgrade would typically reduce the overall lighting consumption by around 50% compared with traditional fluorescent lighting currently installed. A further reduction can be also made by also upgrading the lighting control to incorporate items such as absence detection, daylighting dimming etc.

Much of the lighting installation consists of manual on/manual off.

Building	Area (m2)	Estimated Lighting Load (12 W/m2)	Proposed Lighting Load (6 W/m2)	Existing Annual kWh consumption	Proposed Annual kWh Consumption
Main Block	600	6.8 kW	3.4 kW	6,800	3,400
Block 2	315	3.6 kW	1.8 kW	3,600	1,800
Block 3	399	4.5 kW	2.25 kW	4,500	2,250
Total	**1,314**	**14.9 kW**	**7.45 kW**	**14,900**	**7,450**

FIGURE 29 - LIGHTING UPGRADE OVERVIEW

From the above data, we can evaluate the proposed carbon savings achieved for the replacement lighting schemes per block.

Building	Existing Annual CO2 Emissions (kgCo2)	Proposed Annual CO2 Emissions (kgCo2)	Carbon Reduction
Main Block	1,315	657	50%
Block 2	696	348	50%
Block 3	870	435	50%
Total	**2,881**	**1,440**	

FIGURE 30 - LIGHTING UPGRADE - CARBON REDUCTION

7.4. POWER FACTOR CORRECTION

On many of the site visits it has been observed that the power factor of the buildings has had a largely skewed factor, the result of this is that more power is potentially being used than necessary.

For example, if the power factor for a building is 0.8 for every 1kW of energy paid for, you would effectively receive 800W of actual power. This would mean you are paying 20% more than is required for your electricity.

There are multiple ways to correct this:

1. One solution is to remove any highly inductive loads such as fluorescent lighting.
2. A Second way is to install a power factor correction (PFC) device.

We would in this instance recommend a two-stage approach. Stage one would be to convert the existing fluorescent lighting. Stage two would be reviewing the resulting power factor to see if any enhancements have been made. If there was still a poor power factor correction then we would look to install a PFC unit, which will further reduce the power factor increasing the efficiency of the installation.

7.5. ENERGY METERING

The existing site has limited capability for monitoring. Although this does not directly affect the energy usage of the building itself, energy metering with an interactive interface can give live and historic feed back to the end user and supplement on site energy monitoring and awareness.

7.6. SOLAR PV

Due to the orientation and overall makeup of the roof, it is unlikely that a Solar PV will be viable without supplementary structural support on the existing roofs.

Our initial observation would indicate that a solar array of approximately 8 kWp could be viable to install on the flat roof sections, subject to detailed simulation and structural survey.

FIGURE 31 - FEASIBLE PV LOCATIONS

A value of 8 kWp installed has been analysed for the calculations below to the flat roof with an estimated Yearly yield production of **8,600kWh's**. Varying solar panel types for system efficiency and optimisation could see a slight increase or decrease to this figure.

The below graph provides an estimated monthly energy output from a fixed-angle PV system installed on the flat roof as mentioned.

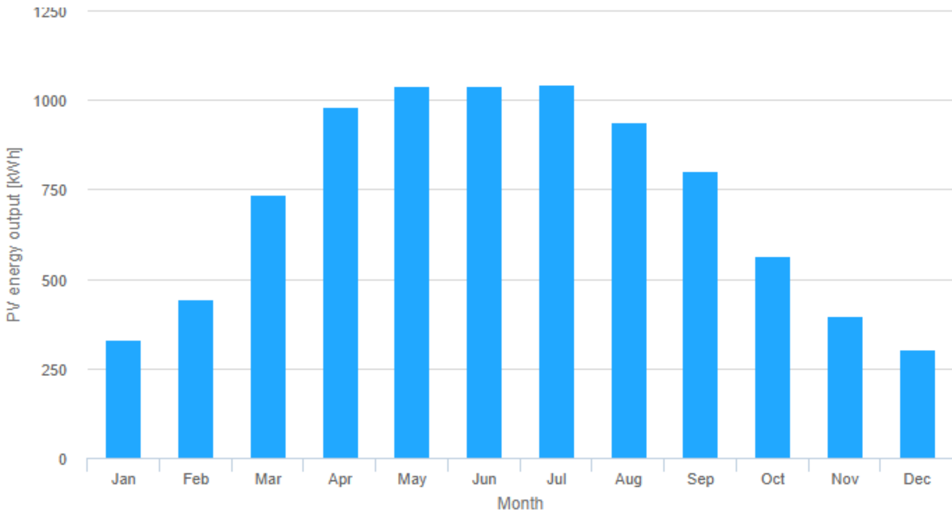


FIGURE 32 - ESTIMATED MONTHLY SOLAR PV YIELD

7.7. FABRIC UPGRADES

A fabric first approach should first and foremost be taken as the main priority for the scheme. Based on the survey undertaken, it would be recommended in the first instance to fill the existing cavity walls.

A vast majority of the external fabric to the blocks is glazing. From survey it can be seen that the existing window units are double glazed and in good condition and achieving a relatively good U-value. When the windows are due for replacement, it would be recommended to explore triple glazing. Existing decarbonisation funding schemes are unlikely to support funding for triple glazing, which are primarily aimed at the replacement of single glazed windows.

As and when financially viable, the remaining roofs should be replaced and improved to add additional insulation and further improve the thermal performance of the roof structure

Due to the constraints, it would not be economically viable to insulate the existing floor without significant disruption and making good.

8. OUTCOME

8.1. PHASED ENERGY REDUCTION

As mentioned through the process and illustrated within the report, a fabric first approach has been taken and established as the next steps in the decarbonisation journey. It is acknowledged with decarbonisation the financial constraints that schemes can have, and the overall extent of works required and therefore a suggested phased approach has initially been provided to assist in discussion of the next step to consider. Works however could be progressed sooner than suggested should future decarbonisation funding schemes become available.

Naturally as part of the transition process from fossil fuels to an all-electric system, there would need to be an upgrade to the electrical incoming mains and subsequent upgrades to the distribution boards. It would be anticipated that the power supply is sized accordingly to the final expected electrical load of the site to suit the phased introduce of ASHP's. It would be suggested for this to occur between Year 2 and 3 (subject to when the works are commissioned).

The graph below shows a stepped approach to the reduction in overall energy usage of the site, considering both fossil fuel usage and electrical usage within the total. Generally, there will be a reduction year by year in reliance of fossil fuels, firstly with reducing the overall heating demand and then secondly converting the system to incorporate an air source heat pump to each block.

In line with the graph below, at the end of Year 6 it is anticipated that the system will primarily be electrically based with the remaining Commercial Kitchen equipment proposed to be converted thereafter from gas to electric.

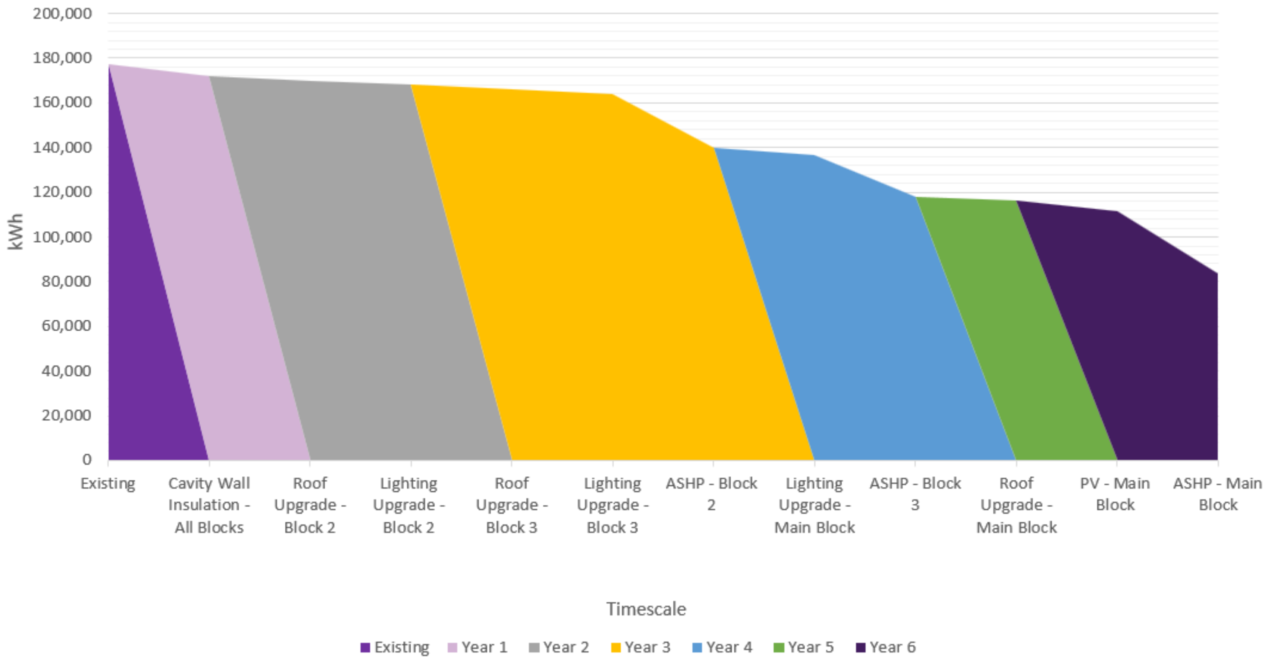


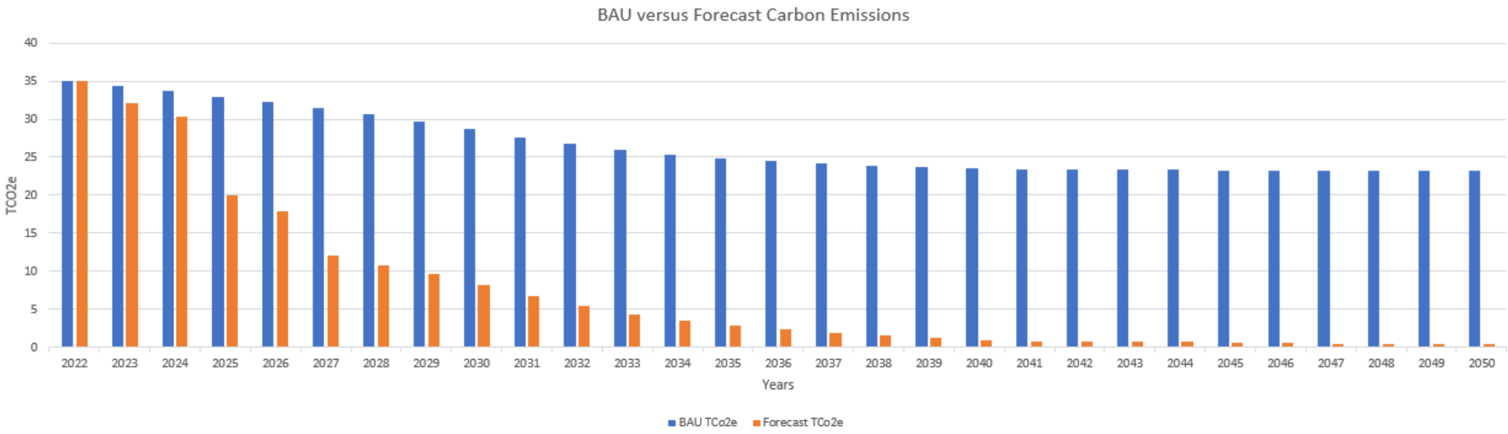
FIGURE 33 - PHASED ENERGY REDUCTION GRAPH

8.2. CARBON EMISSIONS REDUCTION

The below graph provides an estimated illustration of the phased carbon reduction from a period of the yearly recorded data from 2022 for the site to the future trend anticipated to 2050. The graph represents the change in carbon emission factors. At present, gas and electricity are similar for carbon emission factors from the UK grid (oil is the highest in comparison). However, over the last 10 years the carbon emissions factor for electricity has vastly reduced following the further decommissioning of coal fired power stations and increased set-up of further renewable power generation projects such as wind turbine farms, solar panel farms and additional hydropower stations being set-up to name a few.

The blue section of the bar chart represents a *'Business as Usual'* approach with minimal upgrades with the exception of planned maintenance work being undertaken over the years. While some improvements to carbon emissions will naturally be made from improved plant efficiencies, the carbon emissions factor of heating oil will remain almost constant from now until the overall organisation's 2030 net zero initiative and to the overall net zero target for the UK by 2050.

The orange section of the bar chart represents a phased transition to an all-electric system. Over the next decade the carbon emission factor for electricity will noticeably reduce.



8.3. ESTIMATED COST BREAKDOWN

Cost estimates for the proposed solutions have been based on project experience and current industry standards and can be used as budget figures.

The total estimated cost for each energy saving opportunity includes for Standard rates, Builders Work in Connection (BWIC), Prelims and OHP.

Exclusions & Assumptions:

- No allowance for dealing with/ the removal of any asbestos containing materials (ACM's).
- No allowance for PV battery storage.
- Procurement/ Framework fees excluded.
- Works to existing buildings over and above items mentioned below.
- Lighting upgrade allowance excludes re-wiring.
- Costs associated with electrical infrastructure upgrades. Due to the varying costs across the region, a provisional sum is difficult to allocate. It would be recommended to further review this item.
- Internal electrical upgrades to incoming mains distribution boards and local distribution boards.
- Costs for commercial kitchen upgrades includes for replacement of equipment from gas to electric appliances only and does not include for a full kitchen replacement and or wiring/ distribution board upgrades required.
- No measured building survey has been undertaken.

MAIN BLOCK

Energy Saving Opportunity	Total Estimated Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Cavity Wall Insulation	£6,000	£6,000						
Lighting upgrade & Lighting controls upgrade	£68,000		£68,000					
Boiler to High Temperature ASHP, including emitter replacement and distribution pipework	£283,000					£283,000		
Electric Hot Water for Kitchen	£14,000					£14,000		
Installation of Photovoltaics	£24,000						£24,000	
Commercial Kitchen Upgrade – All-Electric Kitchen	£36,000						£36,000	
Total	**£431,000**	**£6,000**	**£68,000**			**£297,000**	**£60,000**	

BLOCK 2

Energy Saving Opportunity	Total Estimated Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Cavity Wall Insulation	£4,000	£4,000						
Roof Upgrade	£115,000		£115,000					
Lighting upgrade & Lighting controls upgrade	£36,000		£36,000					
Boiler to High Temperature ASHP, including emitter replacement and distribution pipework	£143,000			£143,000				
Total	**£298,000**	**£4,000**	**£151,000**	**£143,000**				

BLOCK 3

Energy Saving Opportunity	Total Estimated Cost	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Cavity Wall Insulation	£5,000	£5,000						
Roof Insulation	£142,000		£142,000					
Lighting upgrade & Lighting controls upgrade	£46,000		£46,000					
Boiler to High Temperature ASHP, including emitter replacement and distribution pipework	£189,000				£189,000			
Total	**£382,000**	**£5,000**	**£188,000**		**£189,000**			

9. APPENDIX

The below table indicates the carbon conversion factors used within the report which have been extracted from the “conversion factors 2022” issued by the Department for business, energy & industrial strategy (BEIS). The future values are derived from the “Green book supplementary guidance toolkit spreadsheet” also issued by the BEIS.

Carbon Conversion Factors		
CO2 production, gas	0.2	kg/kW
CO_2 production, oil	0.26	kg/kW
CO_2 production, electric	0.193	kg/kW

The below table indicates the operational profile that has been applied to the site to generate a typical loading profile.

Site Operation	
Days a week	5
Hours a Day	8
Heating weeks	21
Occupied Weeks	39

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